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MILWAUKEE METROPOLITAN AREA AIR POLLUTANT EMISSION INVENTORY

Charles S. Holt

National Air Pollution Control Administration
Durham, North Carolina

February 1969

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16. Abstracts: The sources and emissions of air pollutants are outlined. Total emissions of oxides of sulfur, oxides of nitrogen, hydrocarbons, carbon monoxide and particulate matter are estimated. The emissions of these pollutants are delineated with respect to source type, season of the year, as well as their geographical distribution within the area. The estimates approximate conditions for the year 1967 as closely as possible. The study area included three Standard Metropolitan Statistical Areas; Milwaukee, Racine, and Kenosha. The addition of Walworth county to these three SMSA's made the study area coincide with the area designated by the State of Wisconsin as Region II. Information on 80 major point sources was gathered, emissions calculated, and located on a grid reference system. Emissions not attributable to large point sources were apportioned to the 48 grid squares and contributed to area source totals. For each of the five pollutants, a summary of the emissions in 1967 is tabulated for each of these source categories: transportation (road vehicles, other); stationary sources (industry, residential, commercial, utility power plant); solid waste disposal; and industrial process.

17. Key Words and Document Analysis. 17a. Descriptors

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Urban areas
Exhaust emissions
Inventories
Sulfur oxides
Particles
Carbon monoxide
Hydrocarbons
Nitrogen oxides
Transportation
Ground vehicles
Industrial wastes
Residential buildings
Commerce
Steam electric power generation
Solid waste disposal

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Prepared by:

Charles S. Holt

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

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National Air Pollution Control Administration
Division of Air Quality and Emission Data
Durham, North Carolina

February, 1969

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
ENVIRONMENTAL HEALTH SERVICE
NATIONAL AIR POLLUTION CONTROL ADMINISTRATION

411 West Chapel Hill Street
Durham, North Carolina 27701

Date: April 30, 1970

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Subject: Milwaukee Emission Inventory

To: Files

The following changes should be made in the Milwaukee Emission Inventory Report stationary fuel combustion section:

Source	SOx	Particulates
Steam-Electric Power Plants	173,000	28,300
Industrial	40,240	46,000
Residential	25,800	5,600
Commercial-Institutional	100	1,500
TOTAL	239,140	81,400

Note: I did not check CO, HC, or NOx

Alan J. Hoffman
Sanitary Engineer

PREFACE

This report, which presents the emission inventory of the Milwaukee Area, is another in a series of studies outlining the sources and emissions of air pollutants for major metropolitan areas in the country. These reports provide estimates of total emissions of oxides of sulfur, oxides of nitrogen, hydrocarbons, carbon monoxide and particulate matter. The emissions of these pollutants are delineated with respect to source type, season of the year, as well as their geographical distribution within the area. These surveys are also intended to determine the present level of emissions and status of their control in metropolitan areas.

The general procedure for these surveys is based on the rapid survey technique. The Study area is divided into grid zones that serve as the basis for locating sources and reporting their emissions. All sources of pollution are classified into two general groups, i.e., point sources and area sources. All sources that emit large quantities of air pollutants are considered individually and located specifically within the Area. This latter group, which generally contains about fifty to one hundred sources, typically includes large industries, power plants, and refuse burning facilities. The remaining sources are considered collectively as area sources, and their emissions are reported as

totals for grid zones. This category includes motor vehicles, home heating, smaller industries, onsite refuse burning, etc. The emissions, in both cases, are expressed in terms of tons of pollutant per average annual, summer and winter day.

Emissions for the most part, are estimated using various indicators of pollutant emissions and average emission factors that are related to these. This means that information and data are collected on fuel consumption and refuse burning rates, vehicle miles and gasoline consumption as well as various industrial production rates. These are then translated into emission estimates by use of average emission rates for a particular industry or fuel type. Because of the inherent differences in type of equipment, operating rates, control equipment, and efficiency of operation among the plants and fuel users within a given category, the application of the emission factors to any individual plant or even a smaller number of similar plants or processes may result in a discrepancy between the actual and the estimated emissions. However, the estimates of total pollutants from all sources in the study area should be fairly accurate.

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1. Milwaukee County Department of Air Pollution Control
2. Division of Environmental Protection, Wisconsin State Department of Natural Resources
3. Southeastern Wisconsin Regional Planning Commission

INTRODUCTION

The basic data necessary for the preparation of the Milwaukee area emissions inventory were gathered with the cooperation of the Milwaukee County Department of Air Pollution Control, the Southeastern Wisconsin Regional Planning Commission, and the Wisconsin State Department of Natural Resources, Division of Environmental Protection. Field work for the inventory was conducted in and around the City of Milwaukee in October of 1968. The figures presented herein approximate conditions for the year 1967 as closely as possible. Where 1967 data were not available, estimates were made using necessary assumptions and pre- or post- 1967 data and projections.

The study area considered for this inventory included three Standard Metropolitan Statistical Areas, or SMSA's. These were Milwaukee, Racine, and Kenosha. The addition of Walworth county to these three SMSA's made the study area coincide with the area designated by the State of Wisconsin as Region II. This coincidence made possible the more effective use of statistics compiled by the State of Wisconsin and the Regional Planning Commission on a regional basis.

The grid frame of reference used for the Milwaukee inventory was based on the Universal Transverse Mercator Projection. Forty-eight square grids were defined, of three areas, based on a unit grid square of 25 square kilometers. The smaller squares were superimposed over areas of highest urban, residential, and industrial development.

Information on 80 major point sources was gathered, emissions calculated, and located on the grid reference system. Emissions not attributable to large point sources were apportioned to the 48 grid squares and contributed to area source totals.

SUMMARY

The following is a summary of the results of the air pollution emission inventory of the Milwaukee study area. Each of the five pollutants inventoried is presented, along with the percent contribution* of each source category to the pollutant total. The percentages are extracted from Table 1, which gives study area totals by source category.

Sulfur Oxides	1967 Total = 243,000 Tons	
	Road Vehicles	- 1.1%
	Other Transportation	- .1%
	Fuel Combustion	
	Industrial	16.6%
	Residential	10.6%
	Commercial	-
	Utility Power Plants	71.2%
	Solid Waste Disposal	.1%
	Industrial Process	.1%
Particulates	1967 Total = 100,000 Tons	
	Road Vehicles	3.9%
	Other Transportation	2.8%
	Fuel Combustion	

*Percentages are given to nearest .1%, so they do not necessarily add to 100%.

Particulates (Continued)	Industrial	45.5%
	Residential	5.7%
	Commercial	.1%
	Utility Power Plar	28.3%
	Solid Waste Dispos	8.6%
	Industrial Process	4.9%
Carbon Monoxide	1967 Total = 619,000 Tons	
	Road Vehicles	89.6%
	Other Transportation	4.3%
	Fuel Combustion	
	Industrial	.2%
	Residential	1.0%
	Utility Power Plants	.2%
	Solid Waste Disposal	4.7%
Hydrocarbons	1967 Total = 83,000 Tons	
	Road Vehicles	90.7%
	Other Transportation	3.7%
	Fuel Combustion	
	Industrial	1.2%
	Residential	1.8%
	Utility Power Plants	.5%
	Solid Waste Disposal	2.0%

Nitrogen Oxides	1967 Total = 110,000 Tons
Road Vehicles	30.7%
Other Transportation	6.4%
Fuel Combustion	
Industrial	16.3%
Residential	5.1%
Commercial	.8%
Utility Power Plants	37.2%
Solid Waste Disposal	3.5%

Tables 2,3,4,5,6,7, and 8 present the breakdowns of pollutant emissions for each of the seven constituent counties of the inventory study area.

TABLE 1 SUMMARY OF AIR POLLUTANT EMISSIONS IN THE MILWAUKEE STUDY AREA 1967 (TONS/YEAR)

Source Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation					
Road Vehicles	2,600	3,900	554,500	75,500	33,800
Other	200	2,800	26,500	3,100	7,100
Sub-total	2,800	6,700	581,000	78,600	40,900
Stationary Sources	47,745				
Industry	40,400	45,500	1,500	1,000	17,900
Residential	25,800	5,700	6,000	1,500	5,600
Commercial	100	100	Neg.	Neg.	900
Utility Power Plant	173,000	28,300	1,000	400	41,000
Sub-total	239,300	79,600	8,500	2,900	65,400
Solid Waste Disposal	200	8,600	29,400	1,700	3,800
Industrial Process	200	4,900			
Grand Totals	242,500	99,800	618,900	83,200	110,100

TABLE 2 SUMMARY OF AIR POLLUTANT EMISSIONS
IN KENOSHA COUNTY, 1967

Source Category	Pollutant Emissions Tons/Year				
	SOX	PART.	CO	HC	NOX
Transportation					
Road Vehicles	150	230	27,990	4,140	1,970
Other	25	70	40	85	140
Sub-Total	175	300	28,030	4,225	2,110
Stationary Sources					
Industrial	1,760	2,190	80	30	1,120
Residential	1,990	440	460	120	430
Commercial	10	10	--	--	80
Sub-Total	3,760	2,640	540	150	1,630
Solid Waste	Neg.	430	2,300	140	300
Industrial Process	--	15	--	--	--
Grand Total	3,935	3,370	30,870	4,515	4,040

TABLE 3 SUMMARY OF AIR POLLUTANT EMISSIONS
IN MILWAUKEE COUNTY, 1967

Source Category	Pollutant Emissions Tons/Year				
	SOX	PART.	CO	HC	NOX
Transportation					
Road Vehicles	1,300	1,980	317,700	40,450	17,070
Other	90	2,595	26,330	2,800	6,590
Sub-Total	1,390	4,575	344,030	43,250	23,660
Stationary Sources					
Industrial	42,300	40,000	1,300	900	14,800
Residential	15,920	3,500	3,710	930	3,430
Commercial	70	110	--	--	700
Sub-Total	58,290	43,610	5,010	1,830	5,610
Solid Waste	240	6,730	19,790	1,100	2,500
Industrial Process	220	2,400	--	--	--
Grand Total	60,140	57,315	359,270	46,180	31,770
utility power plant	1,900	16,[illegible]	[illegible]40	[illegible]40	33,[illegible]

TABLE 4 SUMMARY OF AIR POLLUTANT EMISSIONS
IN OZAUKEE COUNTY, 1967

Source Category	POLLUTANT EMISSIONS TONS/YEAR				
	SOX	PART.	CO	HC	NOX
Transportation					
Road Vehicles	110	170	20,750	20,140	1,460
Other	25	70	40	85	140
Sub-Total	135	240	20,790	20,225	1,600
Stationary Sources					
Industrial	500	315	10	5	105
Residential	810	100	190	50	170
Commercial	NA	NA	NA	NA	NA
Sub-Total	1,310	495	200	55	275
Solid Waste	Neg.	100	930	50	120
Industrial Process	--	55	--	--	--
Grand Total	1,445	970	21,920	20,330	1,995

TABLE 5 SUMMARY OF AIR POLLUTION EMISSIONS
IN RACINE COUNTY, 1967

Source Category	Pollutant Emissions Tons/Year				
	SOX	PART.	CO	HC	NOX
Transportation					
Road Vehicles	330	490	60,510	8,960	4,270
Other	25	70	40	85	140
Sub-Total	355	560	60,550	9,045	4,410
Stationary Sources					
Industrial	2,900	2,810	90	40	1,720
Residential	2,480	550	530	150	540
Commercial	10	10	--	--	80
Sub-Total	5,390	3,370	670	190	2,340
Solid Waste	Neg.	560	2,950	170	380
Industrail Process	--	180	--	--	--
Grand Total	5,745	4,670	64,170	9,405	7,130

TABLE 6 SUMMARY OF AIR POLLUTANT EMISSIONS
IN WALWORTH COUNTY, 1967

Source Category	POLLUTANT EMISSIONS TONS/YEAR SOX	PART.	CO	HC	NOX
Transportation					
Road Vehicles	70	110	13,960	2,070	980
Other	NA	NA	NA	NA.	NA
Sub-Total		110	13,960	2,070	980
Stationary Source					
Industrial	NA	NA	NA	NA	NA
Residential	520	110	120	30	110
Commericial	NA	NA	NA	NA	NA
Sub-Total	520	110	120	30	110
Solid Waste	Neg.	180	960	50	120
Industrial Process	--	--	--	--	--
Grand Total	590	400	15,040	2,150	1,210

TABLE 7 SUMMARY OF AIR POLLUTANT EMISSIONS

IN WASHINGTON COUNTY, 1967

Source Category	POLLUTANT EMISSIONS TONS/YEAR SOX	PART.	CO	HC	NOX
Transportation					
Road Vehicles	140	210	25,920	3,840	1,830
Other	NA	NA	NA	NA	NA
Sub-Total	140	210	25,920	3,840	1,830
Stationary Sources					
Industrial	175	75	10	5	90
Residential	890	200	210	50	190
Commercial	NA	NA	NA	NA	NA
Sub-Total	1,065	275	220	55	280
Solid Waste	Neg.	190	1,000	60	130
Industrial	--	40	--	--	--
Grand Total	1,205	715	27,140	3,955	2,240

TABLE 8 SUMMARY OF AIR POLLUTANT EMISSIONS IN WAUKESHA COUNTY, 1967

Source Category	Pollutant Emissions Tons/Year SOX	PART.	CO	HC	NOX
Transportation					
Road Vehicles	470	720	87,700	12,980	6,180
Other	25	70	40	85	140
Sub-Total	495	790	87,740	13,065	6,320
Stationary Sources					
Industrial	130	90	5	5	65
Residential	3,170	700	740	190	680
Commercial	NA	NA	NA	NA	NA
Sub-Total	3,300	790	745	195	745
Solid Waste	Neg.	660	3,510	210	450
Industrial Process	--	2,240	--	--	--
Grand Total	3,795	4,480	91,995	13,470	7,515

GENERAL DISCUSSION

Study Area Characteristics

The Milwaukee study area, as defined for purposes of this inventory, includes three Standard Metropolitan Statistical Areas. Waukesha, Milwaukee, Ozaukee, and Washington Counties make up the Milwaukee SMSA; and Racine and Kenosha Counties are each separate SMSA's. The study area was broadened to include Walworth country, thus making it coincide with the area designated and administered by the State of Wisconsin as Region II. The southern edge of the study area, or the southern border of Kenosha and Walworth Counties, adjoins the Chicago SMSA.

Four of the seven counties in the study area are adjacent to Lake Michigan. Ozaukee, Milwaukee, Racine, and Kenosha account for 83.9 miles of Lake Michigan shoreline. Altogether, the Milwaukee study area covers 2616.3 square miles of land area, and contains 72.8 square miles of inland water surface. Its population is concentrated in the three SMSA cities of Milwaukee, Racine, and Kenosha. Figure 2 presents estimated population density for the area by grid reference square. Table 9 lists estimated country populations for each of the seven counties in the area.[1]

The topography of the area consists of fairly flat land near the lake, graduating to gently rolling prairie terrain towards the western side of the Region. Three small rivers, the Menomonee, Kinnickinnic, and the Milwaukee Rivers, join in the center of urban

Figure 1. The State of Wisconsin showing the location of the Milwaukee study area.

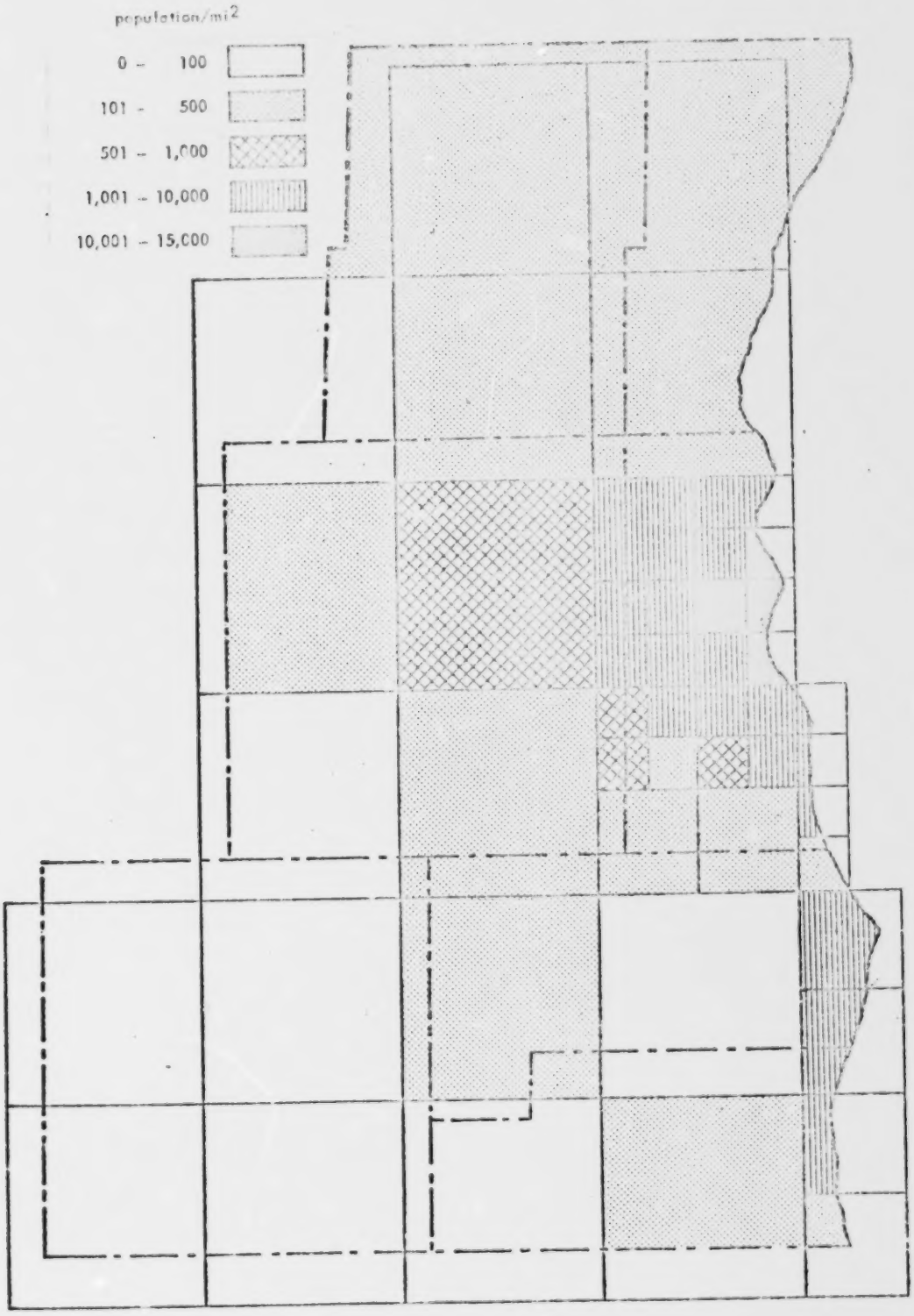

Figure 2. Estimated population density in the Milwaukee study area, 1967.

TABLE 9 POPULATION OF THE MILWAUKEE STUDY AREA BY COUNTY, 1967

County Name	Population
Kenosha	132,000
Milwaukee	1,059,000
Ozaukee	53,000
Racine	169,000
Walworth	55,000
Washington	57,000
Waukesha	201,000

Milwaukee. Their confluence produces a harbor for Lake Michigan water commerce. Much of the industry in Milwaukee County is located along the river valleys.

Approximately 63 percent of the land area of the Region is given over to agriculture and related activities. About 17 percent is woodland, wetland, or unused land.

The important industry of the Region consists largely of light and heavy metals fabrication. A number of firms in the area are engaged in manufacture of machinery, including heavy road vehicles, farm machinery, and electrical machinery. To support this fabrication industry a large number of foundries operate in the area as well. The majority of the metals work done is secondary operation.

The Grid System

The Milwaukee study area is located in Universal Transverse Mercator grid zone 16. A grid system consisting of 48 square grids was designed. Three grid sizes were used, based on a unit grid of 25 square kilometers. The grid sizes used were 25, 100, and 400 square kilometers in area. Twenty-four of the smallest grids were superimposed on the densely populated Milwaukee County area. The balance of the Region was covered with 17 grids of 400 square kilometers and seven grids of 100 square kilometers. Figure 3 diagrams the grid reference system for the Milwaukee study area.

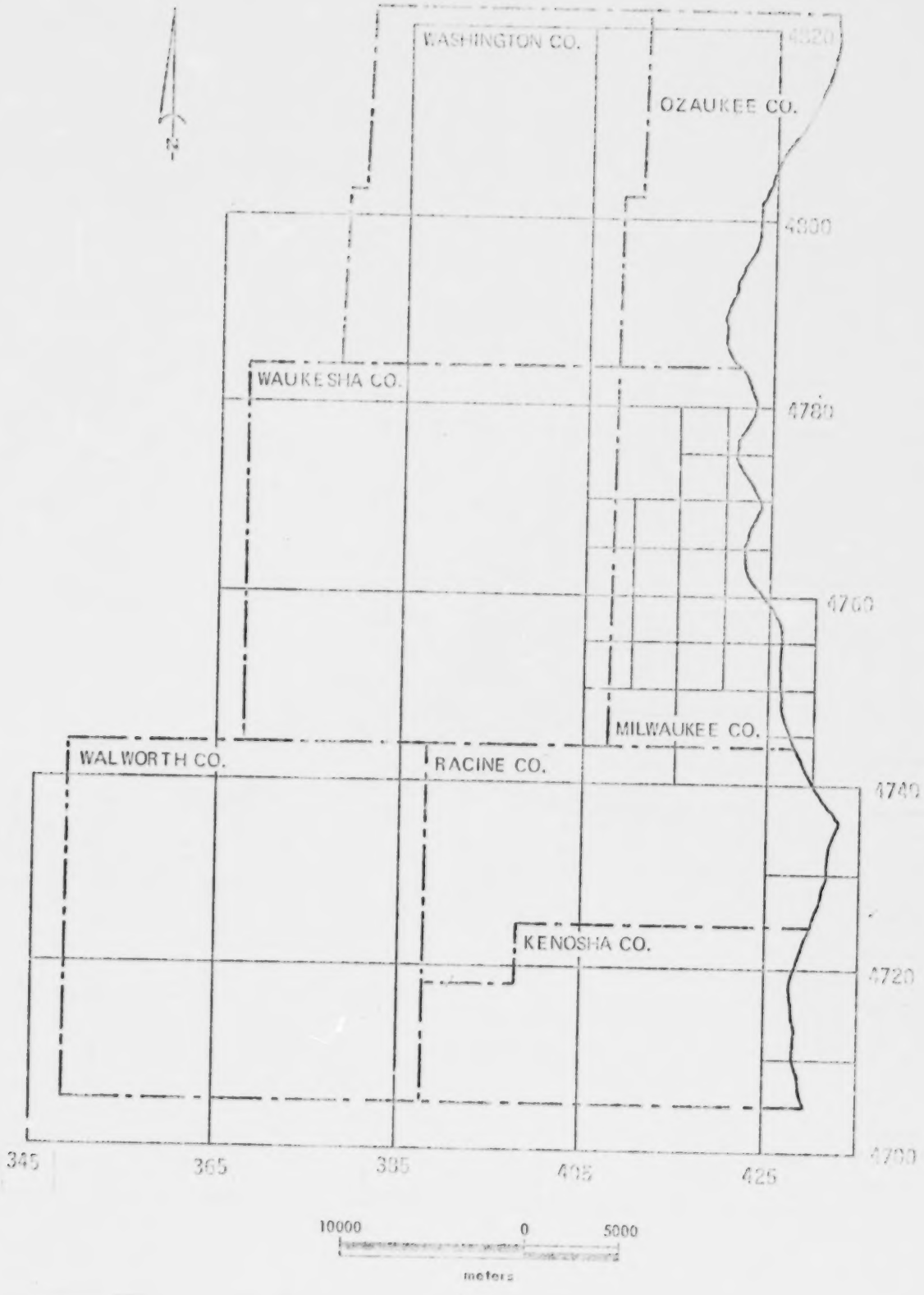

Figure 3. The Milwaukee Study Area Grid Coordinate System.

DISCUSSION OF RESULTS

The emissions catalogued in this inventory were grouped under the following four general source categories:

1. Transportation
2. Stationary Sources
3. Solid Waste Disposal
4. Industrial Processes

The transportation category includes motor vehicles (gasoline and diesel), railroads, aircraft, and vessels. Under the term Stationary Sources come industrial fuel combustion, and utility power generation. The other source category names are self-explanatory. A fifth category, emissions from solvent evaporation, was not considered in this survey. Following is a discussion of the survey results obtained in each of the four categories.

Transportation Sources

Of the four types of transportation sources noted above, motor vehicles accounted for the largest share of pollutant emissions in the Milwaukee area. Motor vehicles burned an estimated 605,192,000 gallons of gasoline and 18,031,000 gallons of diesel fuel in 1967. Motor vehicles, both gasoline and diesel burning, accounted for 2,600 tons (1.1%) of sulfur oxides, 3,900 tons (3.9%) of particulate matter, 554,000 tons (89.6%) of carbon monoxide, 75,500 (91%) tons of hydrocarbons, and 33,800 tons (30.7%) of nitrogen oxides emitted in the study area in 1967.

There are two major airports in the study area, both located in Milwaukee County. Table 10 presents the number and type of aircraft operations conducted over 1967. These two major airports were considered as point sources, and together they emitted approximately 1,900 tons of particulate matter, 26,200 tons of carbon monoxide, 2,500 tons hydrocarbons, and 5,400 tons of nitrogen oxides. Table 11 summarizes emissions from each airport.

Three major railroads were the Milwaukee area. Together these railroads were estimated to have used approximately 17.5 million gallons of diesel fuel, half of which was assumed to have been burned inside the boundaries of the study area. Table 12 details the annual emissions contributed by railroad traffic.

Emissions due to vessels in the area were confined to the waterfront area in the city of Milwaukee. Here are located extensive unloading facilities for the vessels conducting commerce on Lake Michigan. Table 13 details emissions due to vessels.

All transportation other than motor vehicles has been grouped under the term "other transportation" for presentation of their emissions in Table 1. Together, transportation sources produced a total of 2,800 tons of sulfur oxides, 6,700 tons of particulate matter, 581,000 tons of carbon monoxide, 78,600 tons of hydrocarbons, and 40,900 tons of nitrogen oxides.

Stationary Sources

Industrial fuel combustion produced the major portion of stationary source pollutant emissions. Industrial fuel use is

TABLE 10 SUMMARY OF AIRCRAFT OPERATIONS IN TWO MAJOR MILWAUKEE COUNTY AIRPORTS

Airport Name	Aircraft Type	Annual Operations
General Mitchell Field	Commercial	
	Propeller Craft	15,000
	Jets	150,800
	Military	6,700
	Civilian	76,500
Lawrence-Timmerman Airport	Civilian	133,100

TABLE 11 SUMMARY OF AIRCRAFT EMISSIONS THE MILWAUKEE STUDY AREA, 1967

Airport	Emissions, Tons/Year				
	SOX	PART.	CO	HC	NOX
General Mitchell Field	---	1,900	14,100	1,900	3,200
Lawrence-Timmerman Airport	---	400	12,100	600	2,200

TABLE 12 SUMMARY OF ANNUAL RAILROAD EMISSIONS IN THE MILWAUKEE AREA, 1967 TONS/Year

SOX	PART.	CO	HC	NOX
175	480	260	595	970

TABLE 13 EMISSIONS DUE TO VESSELS IN THE MILWAUKEE STUDY AREA, 1967, TONS/YEAR

SOX	PART.	CO	HC	NOX
---	400	---	---	700

presented in Table 14, which also summarizes residential, commercial, and transportation fuel for the Milwaukee area. Industry sources accounted for 40,400 tons of total sulfur oxides (16.6%), 45,500 tons of total particulate matter, (45.5%), 1,500 tons of total carbon monoxide (0.2%), 1,000 tons of total hydrocarbons (1.2%), and 17,900 tons of total nitrogen oxides (16.3%).

Residential space heating ranks as the third largest stationary source of air pollutants in the Milwaukee area. An estimated 5% of the housing units in the area burn coal, 34% burn fuel oil, and 61% burn gas. Most new dwelling units in the Region II area are equipped with gas heating units, so that the proportion of gas heated homes is increasing. Table 15 summarizes the domestic heating mode in the Milwaukee area in 1967.

Residential fuel combustion, then, produced 25,800 tons (10.6%) of total sulfur oxides, 5,700 tons (5.7%) of total particulates, 6,000 tons (1%) of total carbon monoxide, 1,500 tons (1.8%) of total hydrocarbons, and 5,600 tons (5.1%) of total nitrogen oxides.

Commercial sources were not well represented in the survey. It was calculated that commercial users of fuel oil and natural gas were responsible for 100 tons of particulates, 100 tons of sulfur oxides, and about 900 tons of nitrogen oxides. There were no commercial establishments surveyed which used coal.

There are five major utility power generating plants in the Milwaukee study area. Four of these are located in Milwaukee

TABLE 14 SUMMARY OF FUEL USE IN THE MILWAUKEE STUDY AREA, 1967

Fuel Type	Amount	
Gasoline	605,192,000	Gallons
Diesel	181,031,000	Gallons
Railroads	17,896,000	Gallons
Coal		
Industrial	1,018,800	Tons
Residential	230,400	Tons
Steam Electric	4,099,800	Tons
Total	5,349,000	
Residual Fuel Oil		
Industrial	268,000	BBL
Total	268,000	BBL
Distillate Fuel Oil		
Industrial	507,000	BBL
Residential	5,594,500	BBL
Commercial	24,000	BBL
Total	6,125,500	BBL
Natural Gas		
Industrial	54.663×10^9	Cu. ft.
Residential	53.272×10^9	Cu. ft.
Commercial	14.093×10^9	Cu. ft.
Total	122.028×10^9	Cu. ft.

TABLE 15 DOMESTIC HEATING MODE IN MILWAUKEE STUDY AREA BY DWELLING UNITS
1967

County	Coal	Fuel Oil	Natural Gas	Totals
Kenosha	1,900	13,200	23,600	38,700
Milwaukee	15,500	105,300	188,800	309,600
Ozaukee	800	5,300	9,600	15,700
Racine	2,300	15,400	27,600	45,300
Walworth	700	4,400	7,900	13,000
Washington	900	5,800	10,500	17,200
Waukesha	3,100	21,000	37,600	61,700

County, and the fifth is situated in Ozaukee County. These five plants burn coal exclusively as a power source, and together they accounted for 77 percent of the total coal estimated to have entered Region II in 1967. Utility power generation produced 173,000 tons of sulfur oxides (71.2%) of total), 28,300 tons of particulates (28.3% of total). One thousand tons of carbon monoxide (0.2% of total), 400 tons of hydrocarbons (0.5% of total), and 41,000 tons of nitrogen oxides (37.2% of total). Table 16 is a summary of annual emissions by stationary sources, broken down by source and fuel type. It can be seen from these figures that power plant fuel combustion produced the majority of the sulfur oxides emitted in the Milwaukee area and a substantial amount of the nitrogen oxides.

For each major stationary source, information on sulfur content of coal and oil burned and ash content of coal was sought. Where such information was not available, average values were used. These values are presented in Table 17.[3]

Solid Waste

With the exception of Milwaukee County, information concerning the disposal of solid wastes in the study area was extremely sketchy. A number of burning dumps and municipal incinerators were identified in Milwaukee County, and in the other counties of the Region. Only for Milwaukee County, however, were throughputs of these facilities available.

TABLE 16 SUMMARY OF STATIONARY SOURCE EMISSIONS BY FUEL TYPE IN THE MILWAUKEE STUDY AREA 1967

Fuel Type	User Category	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbon	Nitrogen Oxides
Coal	Industrial	37,000	45,200	1,500	500	11,900
	Steam-Electric	173,000	28,300	1,000	400	41,000
	Residential	8,000	4,200	5,800	1,200	900
	Sub-Total	218,000	77,700	8,300	2,100	53,800
Fuel Oil	Industrial	3,400	300	---	500	400
	Residential	17,000	900	200	400	1,400
	Commercial	100	---	---	---	---
	Sub-Total	20,500	1,200	200	900	1,800
Gas	Industrial	---	500	---	---	5,800
	Residential	---	500	---	---	3,200
	Commercial	---	1,500	---	---	9,000
	Sub-Total	Neg.	2,500	Neg.	Neg.	18,000
	Grand Totals	239,300	81,400	8,500	3,000	71,800

TABLE 17 SULFUR AND ASH CONTENTS OF FUELS IN THE MILWAUKEE STUDY AREA

Fuel Type	Percent Sulfur	Percent Ash
Coal*	2.0	7.3
Residual Fuel Oil	1.0	---
Distillate Fuel Oil	.91	---

*Average West Virginia and Illinois Bituminous

Solid waste disposal outside Milwaukee County is left largely to the administration of individual towns. Many of the cities and towns in the rural portion of the Region own or lease their own dumps and landfill sites. Operation of these sites varies widely in efficiency. To have gained a more comprehensive picture of these outlying operations would have required time and effort beyond the scope of this inventory.

Table 18 presents estimated solid waste generation for the seven-county area, and the emissions generated in disposal of this waste. Estimates of solid waste disposal contributing to air pollution were based on information gathered on a sample of the larger towns in the Region. As noted above, more accurate information was available in Milwaukee County.

Based on the estimates, then, disposal of solid wastes in the study area produced 200 tons of sulfur oxides (.1% of total), 8,600 tons of particulates (8.6% of total), 29,400 tons of carbon monoxide (4.7% of total), 1,700 tons of hydrocarbons (2.0% of total), and 3,800 tons of nitrogen oxides (3.4% of total).

Industrial Process

The most important source of the process emissions calculated for this survey was the large number of grey iron foundries and ferrous and non-ferrous casting operations, which provide metal products for the metal fabrication industry. The largest of these were identified, along with the single steel mill in the area.

TABLE 13 SUMMARY OF ESTIMATED SOLID WASTE GENERATION AND EMISSIONS IN THE MILWAUKEE STUDY AREA, 1967

County	Generation Tons/Year	Air Pollutant Emissions, Tons/Year SOX	PART.	CO	HC	NOX
Kenosha	108,400	---	430	2,300	140	300
Milwaukee	810,000	240	6,700	19,700	1,100	2,500
Ozaukee	43,500	---	180	930	50	120
Racine	130,800	---	560	2,950	170	380
Walworth	45,800	---	180	960	50	120
Washington	46,200	---	190	1,000	60	130
Waukesha	165,100	---	600	3,510	210	450
Totals*	1,307,300	200	8,800	31,400	1,800	4,000

*Rounded to nearest hundred

It must be noted that the process emission totals recorded do not represent a majority fraction of area totals. They are included for the sake of completeness. A comprehensive presentation would have required information on a large number of small industries.

Process emissions, then, totalled 200 tons of sulfur oxides (.1% of total), and 4,900 tons of particulate matter (4.9% of the total).

Seasonal Emission Totals

Table 19 and 20 show seasonal variation in total air pollutant emission by grid and seasonal variation of major point sources, respectively. These tables are included in the Appendix to this report. Also, appendiced are Figures 4, 5, 6, 7, and 8, which show mean daily density of the five major pollutants inventoried.

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Seasonal Emission Totals

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METHODOLOGY

All emissions quoted in this report were calculated using emission factors contained in Public Health Service Publication No. 999-AP-42.[4] Following is a discussion of the basis for calculation of emissions in each of the four major source categories.

Transportation

The basis of motor vehicle emissions was a Traffic Analysis Zone map of Region II coupled with 1970 projection of vehicle miles of traffic for each of 619 zones, supplied by the Southeastern Wisconsin Regional Planning Commission. The projections were used to approximate 1967 vehicle traffic. The ratio of diesel to gasoline burning vehicles registered in the State of Wisconsin[5] was used to differentiate between diesel vehicle miles and gasoline burning vehicle miles. Seasonal variation in vehicle emission was derived from Bureau of Roads data on national average monthly vehicle miles of travel.

Aircraft emissions were calculated using the number of annual operations for 1967 out of the two major airports in Region II. Emissions from the use of diesel fuel by the three major railroads in the Region were apportioned over the grids with the greatest concentration of rail lines. It was assumed that fifty percent of the diesel fuel burned by locomotives was burned within the

boundaries of the Region. The combustion of coal by the vessels in the Milwaukee harbor area produced emissions assigned exclusively to grid number 20, the grid square superimposed over the harbor.

Information on aircraft operations was obtained by direct contact with the Milwaukee County agency responsible for administration of the airports. Railroad fuel use was gathered through the Division of Natural Resources, of the State of Wisconsin.

Stationary Sources

The number of dwelling units per Traffic Analysis Zone for 1963 and the projected number for 1970 were the bases for the calculation of residential pollutant emission. Interpolation for each of the 619 zones was made to arrive at 1967 figures, and using the Traffic Analysis Zone Map the number of dwelling units per grid was determined. The basic assumption here was that dwelling units were homogeneously distributed over the traffic zones. The Rapid Survey method, incorporating degree-days, was used to calculate residential space heating emissions for each grid. The method also produced estimates of the total amounts of gas, coal, and fuel oil consumed in domestic space heating in the Region.

Estimations of the total amount of coal, oil, and natural gas burned by industrial sources in the Region II area in 1967 were prepared using statistics from the Census of Manufactures[6] and with the help of the local agencies. Approximately 65 major fuel

users were identified in the Region. Their use of the three fuels was totalled and then subtracted from Region totals.

Rough estimates of fuel oil sold to commercial sources were available from local oil companies. Commercial use of natural gas was detailed rather thoroughly by the major gas companies in the Region. No estimate of commercial coal use was available. Commercial fuel combustion emissions were apportioned over the grid system using land use maps supplied by the Regional Planning Commission.

Each of the major utility power generation plants in the Region was well documented by the local agencies concerning fuel use and method of operation.

Solid Waste

As previously mentioned, information on method and amount of solid waste disposal was sketchy outside Milwaukee County. Theoretical generation of solid waste was calculated using a national average of 4.5 pounds per person per day for the other six counties of the Region. The Milwaukee County Department of Air Pollution Control prepared estimates of actual generation within Milwaukee County.

Based on a sample of fourteen of the larger towns in the rural balance of the Region, it was assumed that fifty percent of the wastes generated in the counties surrounding Milwaukee County contributed to air pollution emissions. Emissions were

calculated using factors for open burning of municipal refuse. Since Milwaukee County constitutes sixty percent of the population of the Region II area, the uncertainties of this method were felt to apply to only 40 percent of the solid waste generation of the Region.

Industrial Process

Through the medium of the Milwaukee County Department of Air Pollution Control and the Wisconsin State Department of Natural Resources, Division of Environmental Protection, information was acquired concerning 80 industrial point sources, 37 of which produced emissions of a type other than that produced by the combustion of fuels. Special effort was made to obtain data concerning the many large foundries in the Region. It should be noted, however, that process emission totals in this inventory do not reflect the total picture, since a small number of the largest process emission sources did not necessarily comprise a significant total of process emissions.

APPENDIX

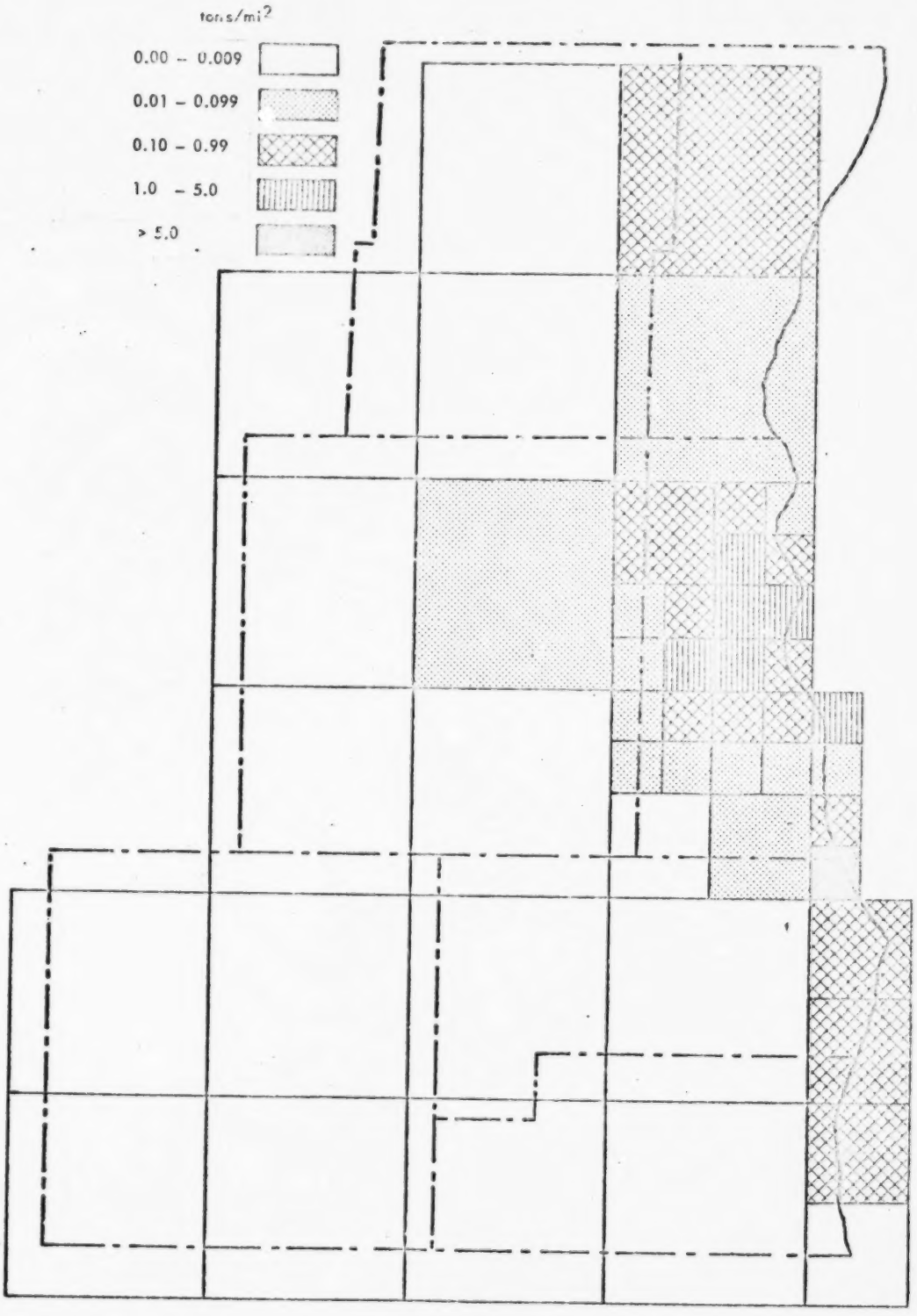

Figure 4. Mean daily density of sulfur oxides in the Milwaukee study area, 1967.

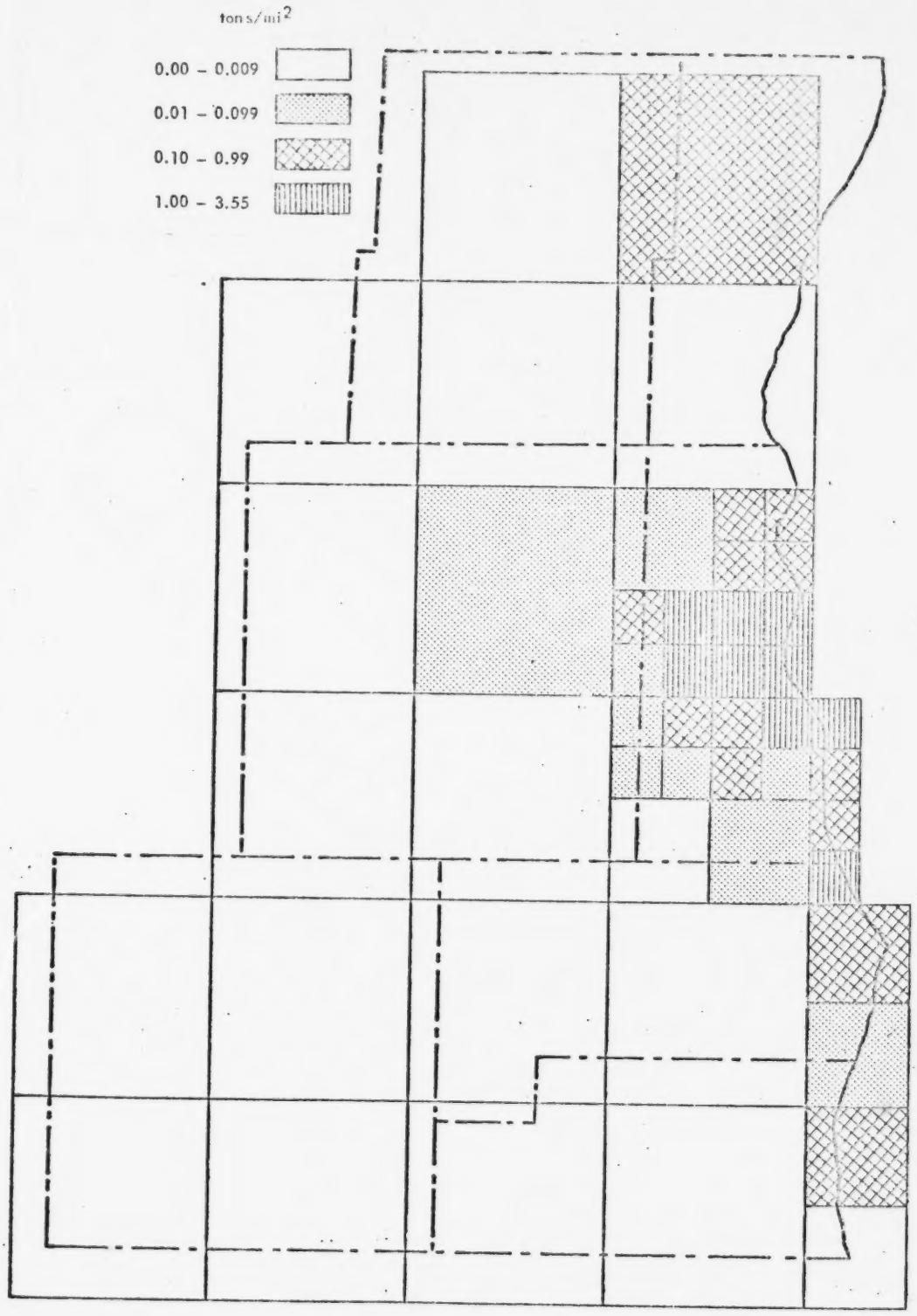

Figure 5. Mean daily density of particulates in the Milwaukee study area, 1967.

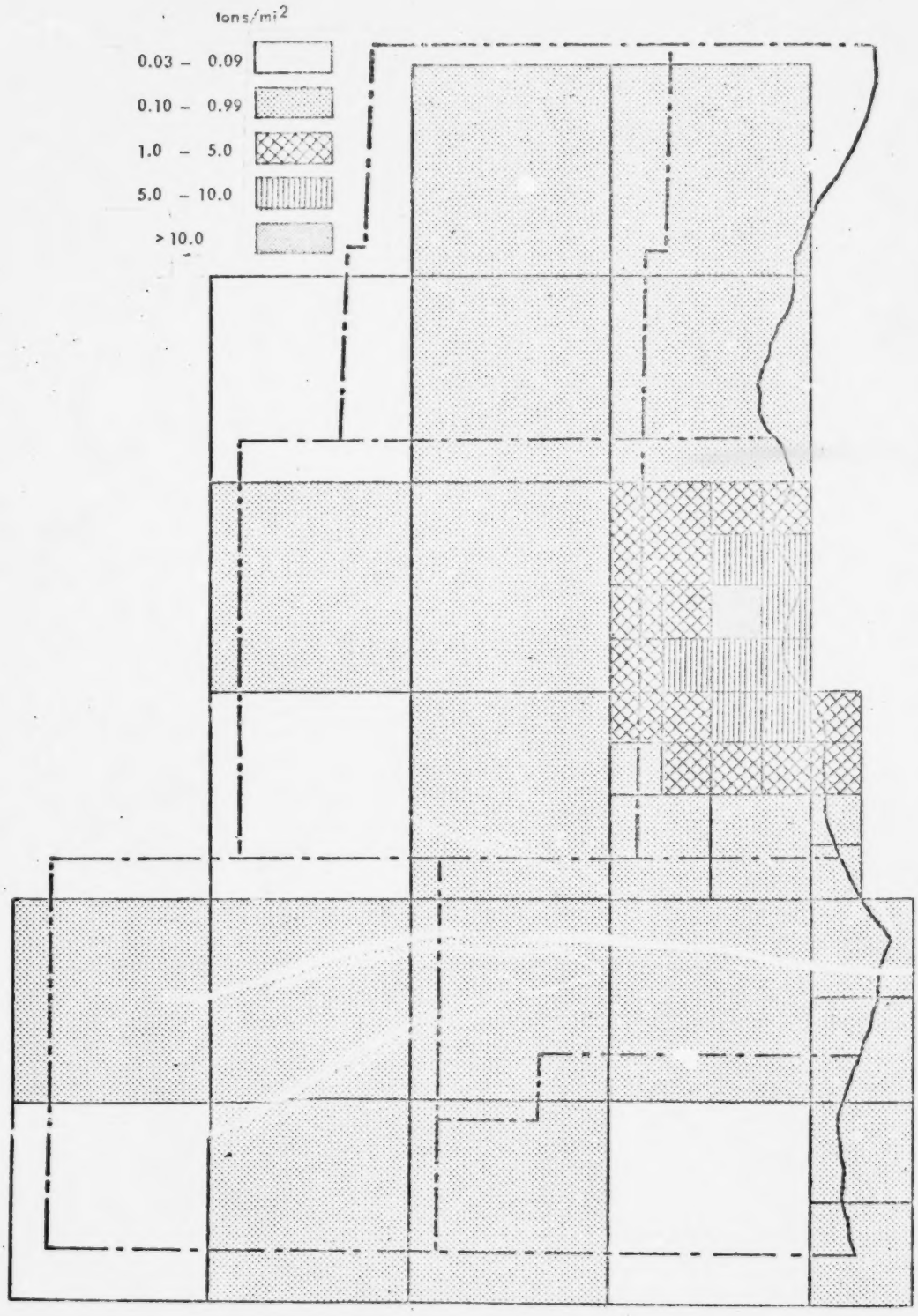

Figure 6. Mean daily density of carbon monoxide in the Milwaukee study area, 1967.

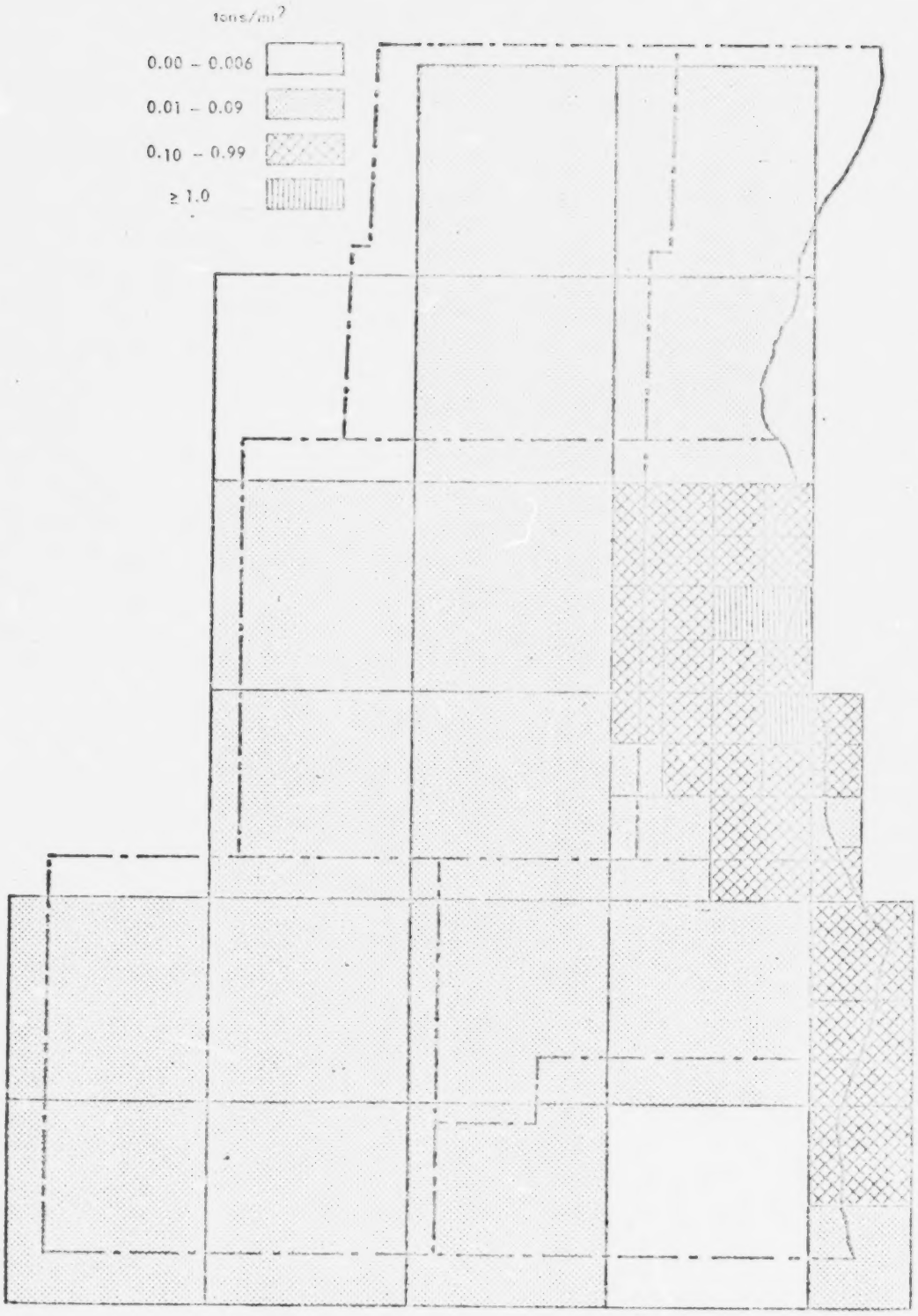

Figure 7. Mean daily density of hydrocarbons in the Milwaukee study area, 1967.

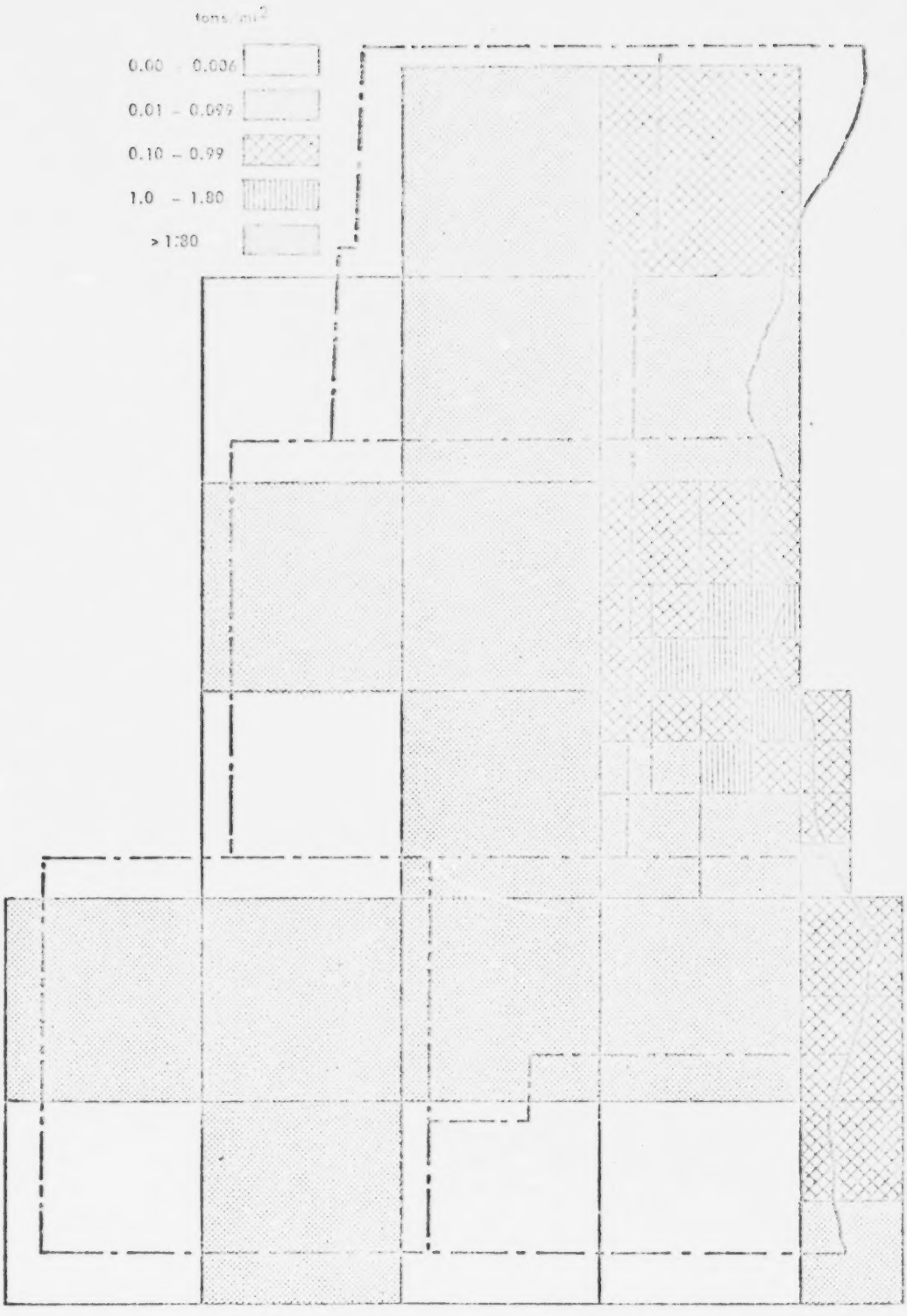

Figure 8. Mean daily density of nitrogen oxides in the Milwaukee study area, 1967.

TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES BY SEASON FOR MILWAUKEE STUDY AREA, 1967 (TONS/DAY)

Source Category	HC	VC	SOX S	SOX W	SOX A	PART. S	PART. W	PART. A	CO S	CO W	CO A	NC S	NC W	NC A	NOX S	NOX W	NOX A
Industrial	3995	48089	0.09	0.10	0.10	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.04
Industrial	4237	48060	0.00	0.18	0.12	0.00	0.10	0.07	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.07	0.03
Industrial	4218	48172	0.23	0.25	0.24	0.21	0.23	0.22	0.02	0.02	0.02	0.01	0.01	0.01	0.12	0.11	0.12
Industrial	3841	47973	0.34	0.40	0.38	0.18	0.21	0.20	0.01	0.02	0.02	0.00	0.01	0.01	0.11	0.11	0.12
Industrial	4059	47818	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Industrial	4164	47823	0.05	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Industrial	4173	47963	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03
Industrial	4153	47959	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03
Industrial	3967	47633	0.00	0.25	0.17	0.00	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.05
Industrial	3886	47782	0.18	0.19	0.21	0.22	0.01	0.02	0.01	0.02	0.01	0.00	0.01	0.01	0.00	0.11	0.13
Industrial	4178	47710	1.22	1.36	1.29	1.95	2.16	2.06	0.06	0.07	0.07	0.02	0.02	0.02	0.42	0.43	0.43
Industrial	4178	47710	2.63	2.91	2.77	1.61	1.79	1.70	0.14	0.15	0.15	0.05	0.05	0.05	1.07	1.07	1.07
Industrial	4184	47745	0.23	0.24	0.24	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.05
Industrial	4217	47715	1.18	1.45	1.31	0.54	0.67	0.61	0.09	0.11	0.10	0.03	0.04	0.03	0.62	0.73	0.69
Industrial	4120	47669	1.89	2.10	1.99	5.98	6.02	6.29	0.15	0.17	0.16	0.05	0.06	0.05	1.00	1.13	1.06
Industrial	4109	47664	9.08	10.06	9.56	6.37	7.06	6.71	0.24	0.26	0.25	0.08	0.09	0.08	1.59	1.76	1.68
Industrial	4173	47666	0.27	0.30	0.28	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.05
Industrial	4190	47692	0.07	0.08	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Industrial	4182	47681	0.11	0.12	0.12	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02
Industrial	4185	47689	0.18	0.19	0.19	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01

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TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES BY SEASON FOR MILWAUKEE STUDY AREA, 1967 (TONS/DAY)
(Continued)

Source Category	HC	VC	SOX S	SOX W	SOX A	PART. S	PART. W	PART. A	CO S	CO W	CO A	NC S	NC W	NC A	NOX S	NOX W	NOX A
Industrial	4215	47675	1.22	1.36	1.28	0.97	1.08	1 02	0.06	0.07	0.07	0.02	0.02	0.02	0.43	0.47	0.45
Industrial	4207	47652	3.32	3.68	3.50	0.55	0.61	0.58	0.17	0.19	0.18	0.05	0.06	0.06	1.17	1.29	1.23
Industrial	4224	47698	0.02	0.02	0.02	1.16	1.16	1.16	0.01	0.01	0.01	0.00	0.00	0.00	3.04	3.	3.0
Industrial	4143	47635	16.26	16.26	16.26	21.87	21.87	21.87	0.37	0.37	0.37	0.12	0.12	0.12	2.74	2.74	2.74
Industrial	4147	47626	1.72	1.91	1.81	1.78	1.97	1.87	0.04	0.05	0.05	0.02	0.02	0.02	0.45	0.50	0.47
Industrial	4172	47626	0.78	0.87	0.82	0.10	0.11	0.10	0.04	0.05	0.04	0.01	0.02	0.01	0.87	0.98	0.92
Industrial	4164	47615	2.84	3.14	2.99	2.72	3.01	2.86	0.15	0.17	0.16	0.05	0.06	0.05	1.09	1.21	1.15
Industrial	4167	47641	0.85	0.94	0.89	0.67	0.74	0.70	0.07	0.07	0.07	0.02	0.02	0.02	0.46	0.51	0.49
Industrial	4169	47620	0.53	0.58	0.56	0.42	0.46	0.44	0.04	0.05	0.04	0.01	0.02	0.01	0.28	0.31	0.29
Industrial	4165	47632	0.42	0.46	0.44	0.33	0.37	0.35	0.03	0.04	0.03	0.01	0.01	0.01	0.22	0.24	0.23
Industrial	4170	47647	6.43	7.12	6.77	1.65	1.83	1.74	0.17	0.19	0.18	0.06	0.06	0.06	1.13	1.25	1.19
Industrial	4153	47643	0.36	0.40	0.38	0.60	0.67	0.64	0.04	0.04	0.04	0.01	0.01	0.01	0.24	0.27	0.25
Industrial	4178	47648	1.74	1.87	1.83	0.11	0.12	0.11	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.05	0.04
Industrial	4203	47645	1.35	1.49	1.42	2.25	2.49	2.37	0.07	0.08	0.07	0.02	0.03	0.03	0.5	0.6	0.55
Industrial	4225	47642	0.17	0.18	0.17	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.03
Industrial	4253	47566	2.09	2.32	2.20	3.16	3.50	3.33	0.10	0.12	0.11	0.04	0.04	0.04	0.72	0.7	0.75
Industrial	4154	47520	0.10	0.11	0.11	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.0	0.02
Industrial	4253	47516	2.69	2.98	2.83	0.82	0.91	0.87	0.06	0.06	0.06	0.02	0.02	0.02	0.49	0.5	0.51
Industrial	4265	47402	3.97	4.40	4.18	7.32	8.11	7.70	0.21	0.23	0.22	0.07	0.08	0.07	1.33	1.5	1.47
Industrial	4307	47340	0.62	0.72	.68	1.05	1.22	1.17	0.02	0.03	0.03	0.01	0.01	0.01	0.16	0.1	0.16
Industrial	4297	47325	0.00	0.08	0.06	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.01

TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES BY SEASON FOR MILWAUKEE STUDY AREA, 1967 (TONS/DAY)

Source Category	HC	VC	SOX			PART.			CO			NOX				
			S	W	A	S	W	A	S	W	A	S	W	A	S	W
Industrial	4313	47309	0.20	0.23	0.22	0.06	0.07	0.07	0.00	0.01	0.01	0.00	0.00	0.00	0.07	0.08
Industrial	4310	47284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	4307	47287	0.56	0.56	0.56	0.30	0.30	0.30	0.02	0.02	0.02	0.02	0.01	0.02	0.16	0.16
Industrial	4304	47284	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	4278	47286	0.00	0.03	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Industrial	4256	47359	2.61	2.61	2.61	0.27	0.27	0.27	0.04	0.04	0.04	0.04	0.04	0.04	1.30	1.30
Industrial	4313	47293	0.07	0.07	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.07	0.07
Industrial	4291	47142	1.14	1.14	1.14	0.27	0.27	0127	0.09	0.09	0.08	0.08	0.08	0.08	0.63	0.63
Power Plant	4249	48048	78.11	78.11	78.11	33.30	33.30	32.84	0.51	0.51	0.51	0.21	0.21	0.20	20.50	20.50
Power Plant	4212	47073	1.58	1.58	1.56	0.84	0.84	0.83	0.01	0.01	0.01	0.00	0.00	0.00	0.42	0.42
Power Plant	4217	47661	8.68	8.68	8.57	2.36	2.36	2.33	0.06	0.06	0.06	0.02	0.02	0.02	2.29	2.29
Power Plant	4261	47585	25.60	25.60	25.24	7.99	7.99	7.88	0.17	0.17	0.17	0.07	0.07	0.07	6.74	6.74
Power Plant	4281	47443	366.60	366.60	361.58	34.23	34.23	33.76	2.10	2.10	2.07	0.86	0.86	0.85	88.07	88.07
Incinerator	4105	47743	.16	.16	.16	1.39	1.39	1.39	.03	.03	.03	.16	.16	.16	.03	.16
Incinerator	4109	47617	.16	.16	.16	1.39	1.39	1.39	.03	.03	.03	.16	.16	.16	.02	.16
Incinerator	4224	47646	.06	.06	.06	.56	.56	.56	.03	.03	.03	.06	.06	.06	.01	.06
Incinerator	4212	47737	.01	.01	.01	.05	.05	.05	.00	.00	.00	.01	.01	.01	.00	.01
Incinerator	4228	47711	.01	.01	.01	.10	.10	.10	.01	.01	.01	.01	.01	.01	.00	.01
Incinerator	4106	47674	.05	.05	.05	.47	.47	.47	.03	.03	.03	.05	.05	.05	.01	.01
Incinerator	4159	47625	.08	.08	.08	.67	.67	.67	.04	.04	.04	.08	.08	.08	.01	.01
Incinerator	4265	47505	.01	.01	.01	.09	.09	.09	.01	.01	.01	.01	.01	.01	.00	.01

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TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINT SOURCES BY SEASON FOR MILWAUKEE STUDY AREA, 1967 (TONS/DAY)

Source Category	HC	VC	SOX S	SOX W	SOX A	PART. S	PART. W	PART. A	CO S	CO W	CO A	HC S	HC W	HC A	NOX S	NOX W	NOX A
Process						.11	.11	.11									
Process	4154	47939				.02	.02	.02									
Process	4173	47963				.01	.01	.01									
Process	4176	47967				.07	.07	.07									
Process	4177	47962				.05	.05	.05									
Process	3961	47655				5.0	5.0	5.0									
Process	3967	47633				.00	.00	.00									
Process	3966	37702				--	--	--									
Process	3970	47742				1.0	1.0	1.0									
Process	3962	47630				.10	.10	.10									
Process	3969	47633				.04	.04	.04									
Process	4177	47735				0.25	0.25	0.25									
Process	4145	47609				.10	.10	.10									
Process	4193	47645				.25	.25	.25									
Process	4154	47634				.14	.14	.14									
Process	4173	47617				.60	.60	.60									
Process	4197	47645				.05	.05	.05									
Process	4160	47620	.60	.60	.60	.00	.00	.00									
Process	4214	47603				1.45	1.45	1.45									
Process	4213	47626				.09	.09	.09									
Process	4146	47636				.06	.06	.06									

TABLE 19 SUMMARY OF AIR POLLUTANT EMISSIONS FROM POINTSOURCES BY SEASON FOR MILWAUKEE STUDY AREA, 1987 (TONS/DAY)

Source Category	HC	VC	SOX			PART.			CO			HC			NOX		
			S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
Process	4141	47629				.11	.11	.11									
Process	4140	47636				1.66	1.66	1.66									
Process	4123	47601				.00	.00	.00									
Process	4205	47513				.00	.00	.00									
Process	4252	47316				.43	.43	.43									
Process	2330	47233				.00	.00	.00									
Process	4307	47340				.11	.11	.11									
Process	4302	47340				.10	.10	.10									
Process	4297	47326				.03	.03	.03									
Process	4307	47307				.24	.24	.24									
Process	4313	47304				.01	.01	.01									
Process	4293	47309				.01	.01	.01									
Process	4283	47134				.01	.01	.01									
Process	4201	47142				.03	.03	.03									
Process	4178	47048				.58	.58	.58									
Process	4178	47048				.31	.31	.31									

TABLE 20 SEASONAL VARIATION OF TOTAL AIR POLLUTION EMISSIONS BY GRID FOR THE MILWAUKEE STUDY AREA, 1967

Grid	SOx			PART.			CO			HC			NOx		
	S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
1	.32	2.63	1.41	.46	.93	.67	34.26	10.44	32.34	4.00	1.48	4.73	3.57	2.71	[illegible]
2	78.52	79.90	79.17	33.95	34.30	34.30	24.19	24.13	24.40	3.74	3.30	3.55	[illegible]	[illegible]	[illegible]
3	.30	1.17	.76	.39	.57	.40	6.21	5.09	5.95	.83	.72	.89	.60	.47	.[illegible]
4	.25	2.11	1.38	.00	.98	.77	32.59	34.96	37.26	5.77	5.11	5.45	5.05	3.15	[illegible]
5	.52	5.26	2.73	.93	1.90	1.38	62.66	50.68	59.14	9.07	8.17	9.00	8.01	5.07	[illegible]
6	.24	2.26	1.19	.47	.88	.45	37.36	33.07	35.19	5.48	4.87	5.18	5.70	2.78	[illegible]
7	.87	8.0	4.23	7.36	17.64	8.05	99.09	87.88	93.43	14.59	13.11	13.94	7.18	7.64	[illegible]
8	.71	10.23	5.10	1.99	3.09	1.92	141.66	120.92	135.66	20.44	18.14	19.30	7.07	5.17	[illegible]
9	.18	2.44	1.25	1.00	1.46	1.23	26.94	24.34	25.62	3.92	3.00	3.19	1.94	2.15	[illegible]
10	.10	1.45	.74	.80	1.17	1.02	22.02	19.04	20.93	2.58	2.31	2.46	1.39	1.69	[illegible]
11	5.28	15.07	9.89	6.72	9.11	7.85	71.04	64.39	68.74	8.99	8.41	8.68	7.42	6.07	[illegible]
12	1.83	8.17	4.84	1.95	3.37	2.63	51.33	46.35	49.85	6.33	5.82	6.10	5.42	[illegible]	[illegible]
13	.22	1.09	.61	.84	1.15	1.03	29.22	25.88	27.53	4.04	3.54	3.81	1.74	[illegible]	[illegible]
14	5.33	11.86	6.92	12.87	14.69	13.73	49.48	44.75	47.08	6.14	5.70	5.91	[illegible]	7.92	[illegible]
15	14.44	20.35	20.27	13.77	16.29	15.20	105.64	94.84	100.17	13.43	12.37	12.88	[illegible]	[illegible]	[illegible]
16	19.45	30.60	23.87	13.06	13.51	13.16	91.07	82.13	86.53	11.47	10.61	11.03	[illegible]	[illegible]	[illegible]
17	.11	1.43	.73	.30	.58	.42	18.23	16.27	17.24	2.46	2.23	2.37	[illegible]	[illegible]	[illegible]
18	22.42	29.35	25.37	31.10	32.26	31.48	71.07	63.67	67.34	8.95	8.10	8.57	[illegible]	[illegible]	[illegible]
19	37.20	47.03	41.92	17.88	20.33	19.04	68.03	61.61	64.74	8.71	8.15	[illegible]	[illegible]	[illegible]	[illegible]

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TABLE 20 SEASONAL VARIATION OF TOTAL AIR POLLUTION EMISSIONS BY GRID FOR THE MILWAUKEE STUDY AREA, 1967

	SOX			PART.			CO			HC			NOX	
Grid	S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
20	5.99	11.60	8.62	12.30	13.70	12.96	63.14	56.60	59.83	7.87	7.20	7.52	[illegible]	9.55	[illegible]
21	.09	.60	.33	.34	.44	.39	11.18	9.95	10.57	1.63	1.47	1.54	.87	1.03	.92
22	.31	2.39	1.28	.62	1.03	.81	43.88	38.75	41.30	6.52	5.82	6.17	3.84	5.30	[illegible]
23	.09	.74	.40	.28	.42	.34	17.11	15.15	16.13	2.29	2.04	2.16	1.10	1.14	1.12
24	3.88	6.70	5.20	8.55	9.14	8.82	35.53	31.95	33.72	4.33	3.96	4.14	3.86	3.98	[illegible]
25	3.92	7.55	4.88	6.81	6.85	6.83	53.60	47.09	50.34	6.74	5.92	6.33	4.41	4.14	[illegible]
26	3.97	8.14	5.93	12.03	12.89	12.45	90.44	85.06	87.72	15.16	14.51	14.78	9.13	8.54	[illegible]
27	27.76	29.56	28.25	11.97	12.65	12.09	12.56	11.74	12.13	1.45	1.38	1.42	8.31	8.69	[illegible]
28	.04	.65	.33	.21	.34	.28	7.11	6.85	6.77	.80	.82	.86	.50	.78	.63
29	.04	.32	.18	.80	.87	.83	10.51	9.60	10.65	1.11	1.01	1.06	.78	.76	.76
30	.20	.79	.48	.93	1.06	1.00	15.60	14.06	14.85	1.87	1.70	1.78	1.82	1.47	[illegible]
31	.10	.78	.42	.88	1.02	.95	22.54	20.15	21.34	2.64	2.36	2.50	1.41	1.41	1.41
32	.08	1.73	.86	1.43	1.78	1.59	11.33	10.63	10.97	1.21	1.18	1.19	.91	1.10	.95
33	.06	.42	.22	.24	.31	.28	11.78	10.44	11.10	1.52	1.33	1.43	.78	.78	.78
34	.19	.94	.54	1.06	1.20	1.13	34.65	30.70	32.68	4.51	4.02	4.26	2.42	2.34	[illegible]
35	9.57	11.65	7.10	8.33	9.27	8.79	5.39	4.92	5.15	.68	.63	.75	2.01	2.41	[illegible]
36	366.54	369.80	361.70	34.51	34.54	34.06	6.32	5.93	6.09	1.48	1.42	1.43	[illegible]	[illegible]	[illegible]
37	.13	1.36	.71	.34	.59	.46	21.18	18.81	19.98	3.05	2.73	2.89	1.55	1.63	1.57
38	.14	.96	.52	.36	.52	.43	24.47	21.41	22.87	3.51	3.11	3.30	1.76	1.72	1.71
39	.14	1.61	.83	.34	.64	.48	20.84	18.57	19.70	3.00	2.70	2.83	1.62	1.67	1.61
40	.30	1.39	.81	.60	.81	.68	52.60	46.09	49.34	7.70	6.77	7.23	3.76	3.51	[illegible]
41	4.87	11.35	7.95	7.70	9.23	8.46	35.98	32.90	34.41	5.40	5.09	5.23	[illegible]	6.72	7.01

TABLE 20 SEASONAL VARIATION OF TOTAL AIR POLLUTION EMISSIONS BY GRID FOR THE MILWAUKEE STUDY AREA, 1967

	SOX			PART.			CO			HC			NOX		
Grid	S	W	A	S	W	A	S	W	A	S	W	A	S	W	A
42	3.52	7.52	5.42	1.47	2.32	1.85	29.60	26.77	28.16	4.40	4.12	4.26	5.36	5.03	5.19
43	.30	.95	.49	.26	.45	.36	13.16	11.75	12.44	1.86	1.67	1.77	.93	1.35	1.14
44	.15	1.70	.87	.35	.57	.50	22.66	20.17	21.41	3.27	2.94	3.11	1.65	1.77	1.71
45	.11	1.08	.56	.32	.51	.41	18.28	16.22	17.24	2.62	2.34	2.48	1.34	1.38	1.36
46	.05	1.30	.64	.22	.48	.35	6.20	5.75	5.93	.82	.79	.81	.46	.79	.62
47	5.17	11.99	8.38	6.57	8.03	7.25	36.27	33.27	34.72	5.34	5.06	5.19	5.91	7.16	6.53
48	.03	.31	.16	.20	.26	.23	5.66	5.11	5.38	.75	.68	.72	.34	.46	.40

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